2-Way Traffic Light System

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Section : **1**

Course Code : **MCTE 2332**

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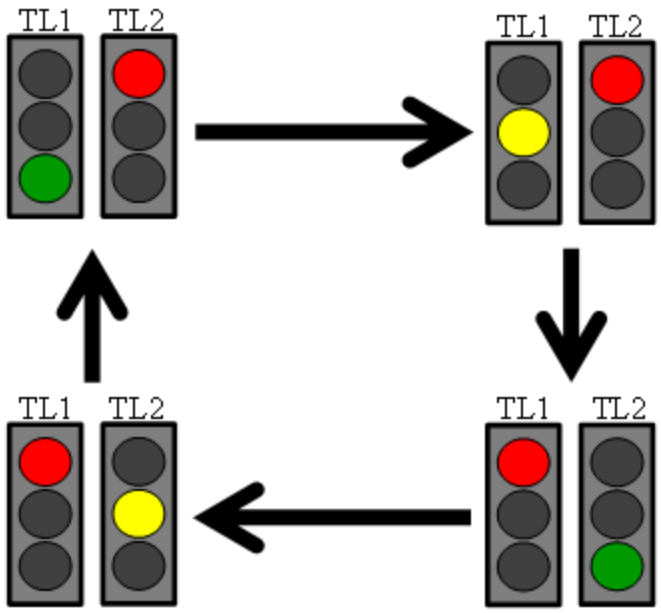
1. Goal of The Project

This project aims to design a two-way traffic light to ensure the safety of drivers on the road. Since traffic lights are designed, hence there are three types of lights involved in this design as Red, Green, and Yellow. The red light indicates the driver to stop their vehicle upon reaching the yellow line before the junction. The yellow light indicates the driver to slow down their vehicle and prepare to stop their vehicle meanwhile Green light allows the driver to move their vehicle. Since this is a two-way traffic light design, it has four combinations of colour signal from the two traffic lights. The first combination is Green light from the first traffic light and Red light from the second traffic light which allows vehicles on the first street to move and vehicles from the second street to stop. The second combination of this design is Yellow light from the first traffic light and Red light from the second traffic light which indicates the vehicles on the first street to slow down their vehicle and prepare to stop while the vehicles from the second street remain at rest. Thirdly, the next combination is Red light from the first traffic light and Red light from the second traffic light which signals both vehicles at both streets to stop and remain at rest for a few seconds. Lastly, the final combination is Red light from the first traffic light and Green light from the second traffic light which allows vehicles on the second street to move and the vehicles from the first street to stop. In this design, three JK Flip Flops are used since it has six states which are Red-Red, Red-Green, Red-Yellow, Red-Red, Green-Red, and Yellow-Red.

2. Design Process

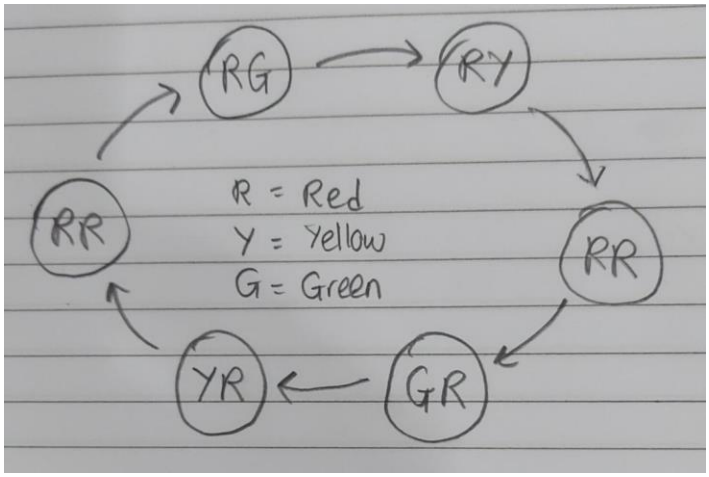


The sequences of the two traffic lights combination are shown in the diagram above. In designing the circuit, the state diagram of the two traffic lights' combinations sequences is created to ensure that the accuracy of the traffic lights' combinations display. It starts from Red-Red to Red-Green to Red-Yellow to Red-Red to Green-Red to Yellow-Red and lastly Red-Red again. Therefore, a state table for the combinations of the two traffic lights can be created which gives 6 states. Hence, three T-Flip Flops are used in this project. Next, the excitation table which shows the relationship between the traffic lights and output of T Flip-Flops (Q2, Q1, Q0) is produced. However, since there are only 6 states, the 7^{th} state, and the 8^{th} state are assumed to return to Red-Red state for safety reasons. Upon deriving the combination of the logic circuit from the excitation table, six outputs are obtained which are Red 1, Yellow 1, Green 1, Red 2, Yellow 2, and Green 2 for the two traffic lights. The output equations show which light will be turned on from both traffic lights by the combinations of output from the T-Flip Flops. The next process is creating a state diagram and excitation table for the three T-Flip Flops where the 7^{th} and 8^{th} states are used to return to the 1^{st} state for safety purposes. From K-Map, the output equations for the three T-Flip Flops have been successfully

derived. Lastly, the schematic diagram of the circuit is drawn and verified by using Logisim.

3. Detailed Design

(a) State Diagram of Two Light Combinations



(b) State Table

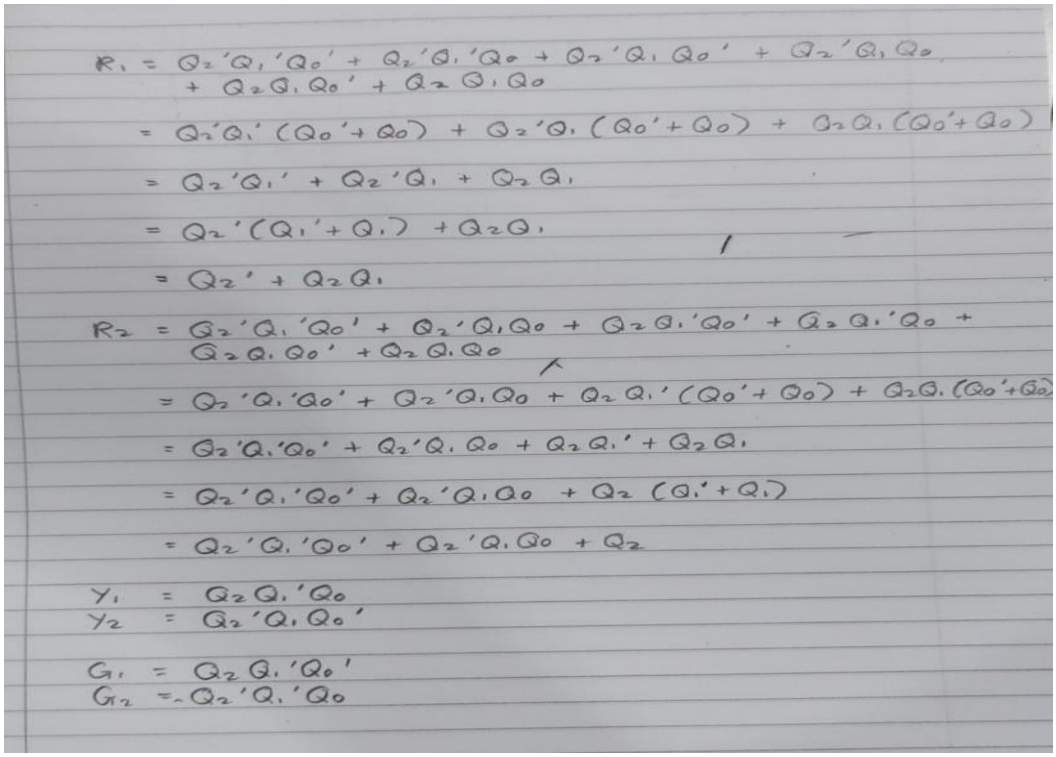
	Present State	Next State
State	Combination	Combination
0	RR	RG
1	RG	RY
2	RY	RR
3	RR	GR
4	GR	YR
5	YR	RR

(c) Excitation Table of the Two Traffic Lights

Since there are 6 states from the combination table, 3 Flip Flops are used. However, the 7th and 8th states are assigned as Red-Red combinations for safety purposes.

			First Traffic Light			Second Traffic Light		
State	Combination	Q2 Q1 Q0	R1	Y1	G1	R2	Y2	G2
0	RR	000	1	0	0	1	0	0
1	RG	001	1	0	0	0	0	1
2	RY	010	1	0	0	0	1	0
3	RR	011	1	0	0	1	0	0
4	GR	100	0	0	1	1	0	0
5	YR	101	0	1	0	1	0	0
6	RR	110	1	0	0	1	0	0
7	RR	111	1	0	0	1	0	0

(d) Output Equation



R1 = Q2' + Q2Q1

R2 = Q2'Q1'Q0' + Q2'Q1Q0 + Q2

Y1 = Q2Q1'Q0

Y2 = Q2'Q1Q0'

G1 = Q2Q1'Q0'

G2 = Q2'Q1'Q0

(e) Identification of Type of Flip Flops and Amount of Flip Flops Used

Since there are six states;

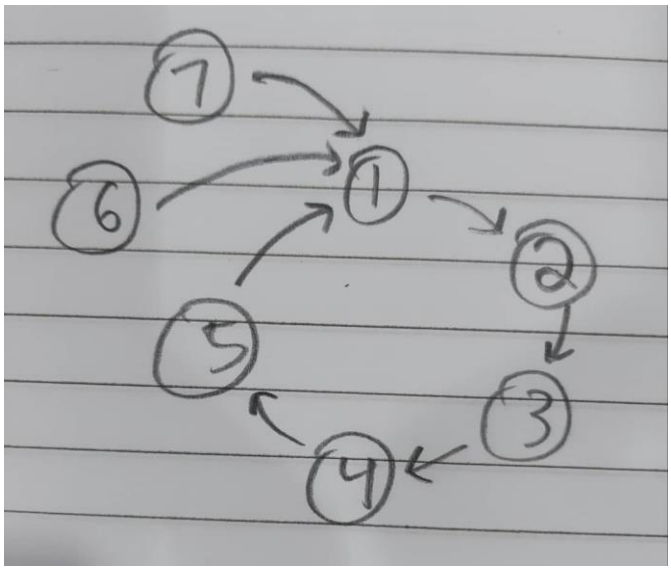
No. of Flip Flops : 3

Type of Flip Flops : T Flip Flops

(f) Excitation of T Flip Flop Table

Q	Q_{n+1}	T
0	0	0
0	1	1
1	0	1
1	1	0

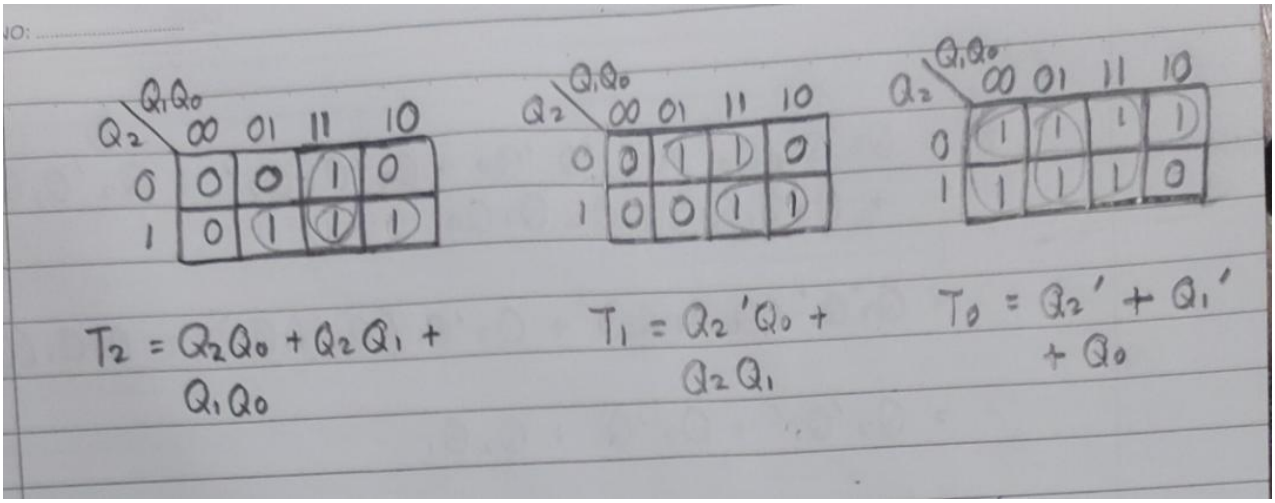
(g) State Diagram



(h) Circuit Excitation Table

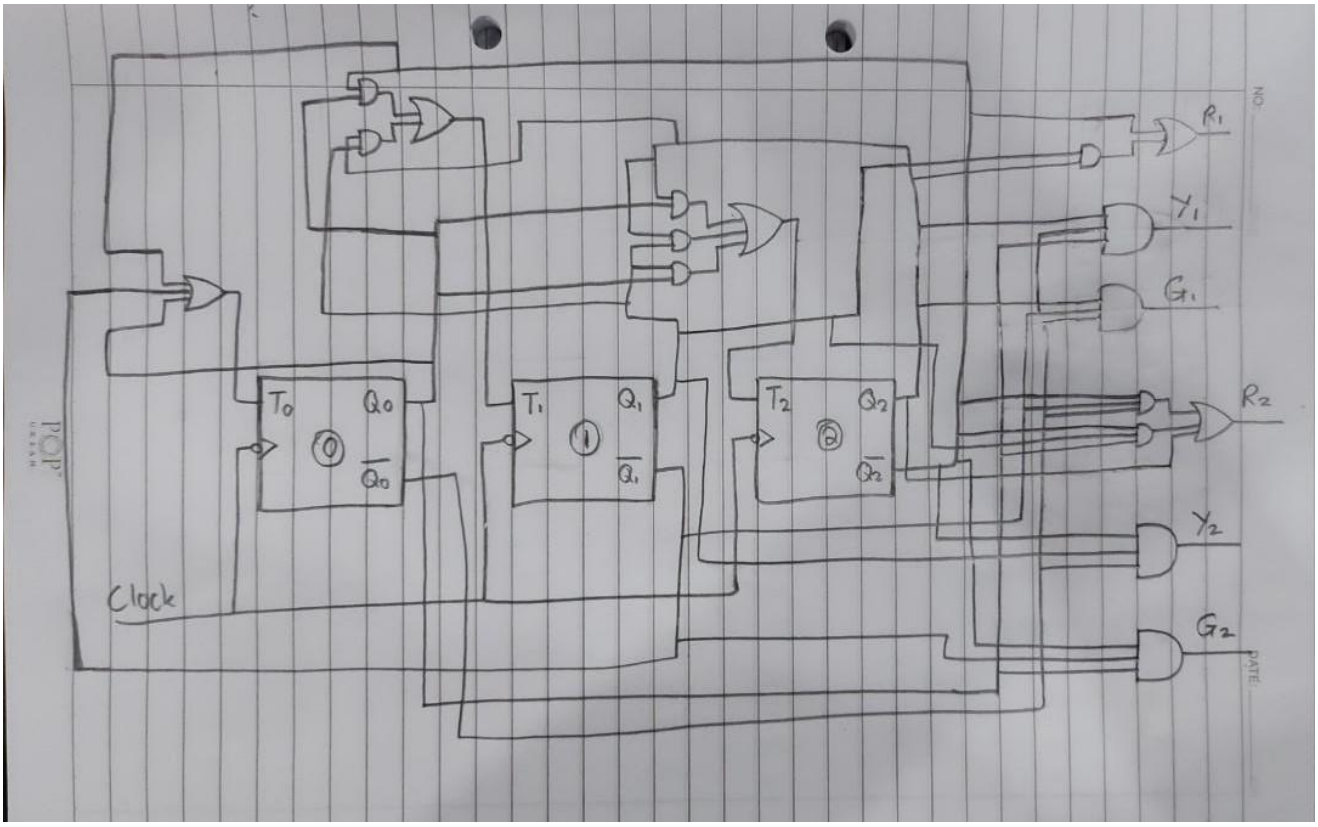
Present State			Next State					
Q2	Q1	Q0	Q2+	Q1+	Q0+	T2	T1	T0
0	0	0	0	0	1	0	0	1
0	0	1	0	1	0	0	1	1
0	1	0	0	1	1	0	0	1
0	1	1	1	0	0	1	1	1
1	0	0	1	0	1	0	0	1
1	0	1	0	0	0	1	0	1
1	1	0	0	0	0	1	1	0
1	1	1	0	0	0	1	1	1

(i) Output Equation

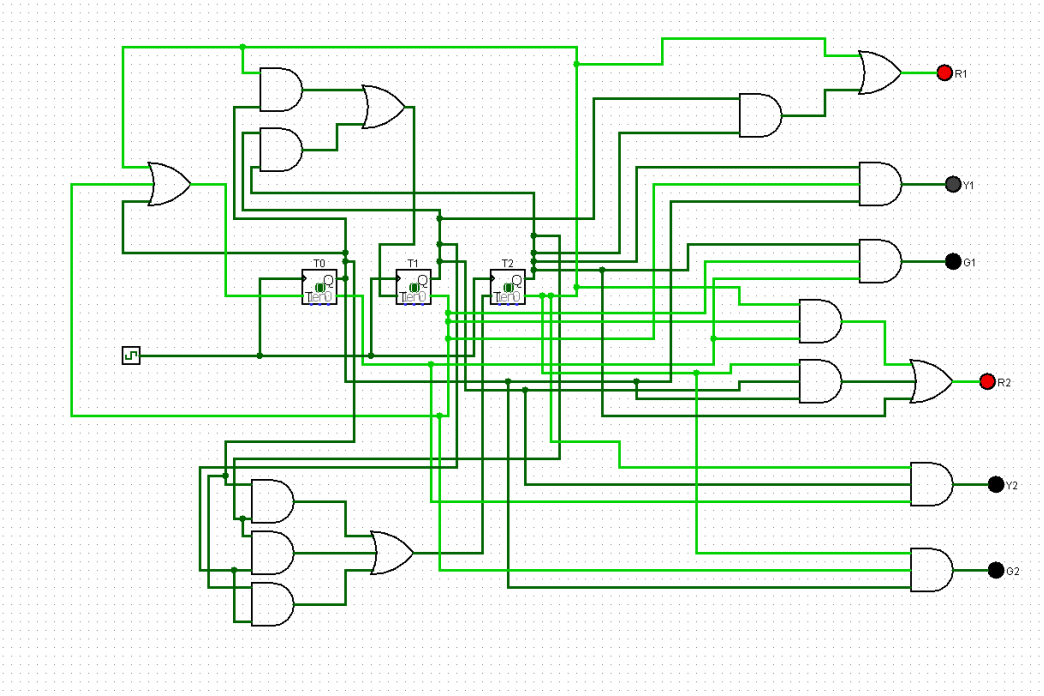


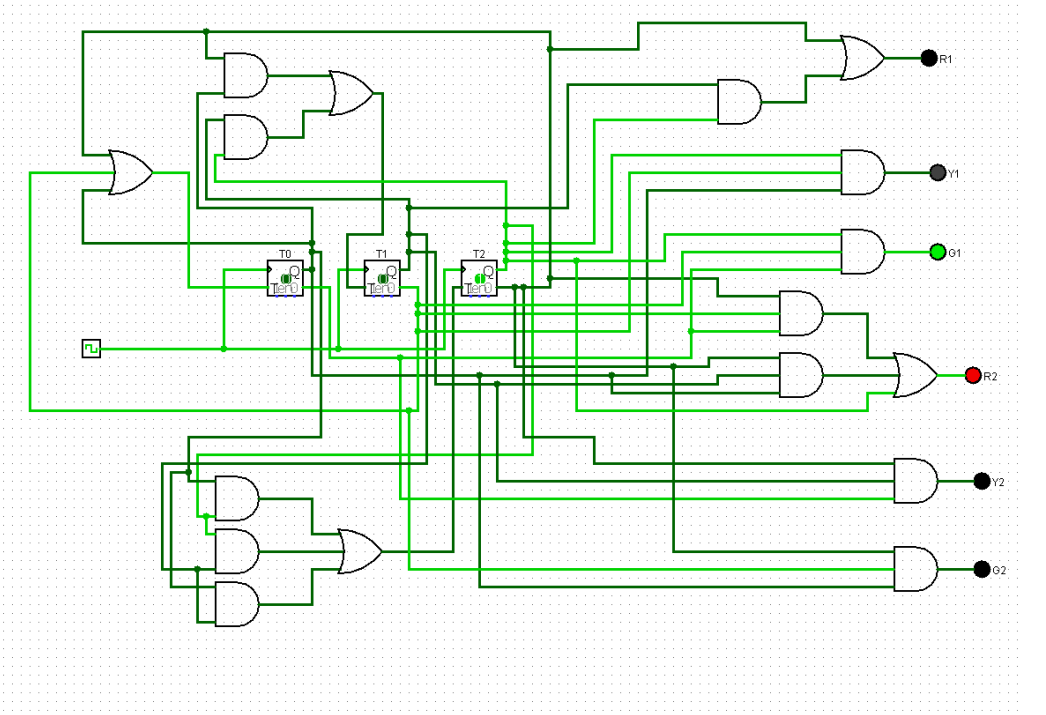
T2 = Q2Q0 + Q2Q1 + Q1Q0
T1 = Q2'Q0 + Q2Q1
T0 = Q2' + Q1' + Q0

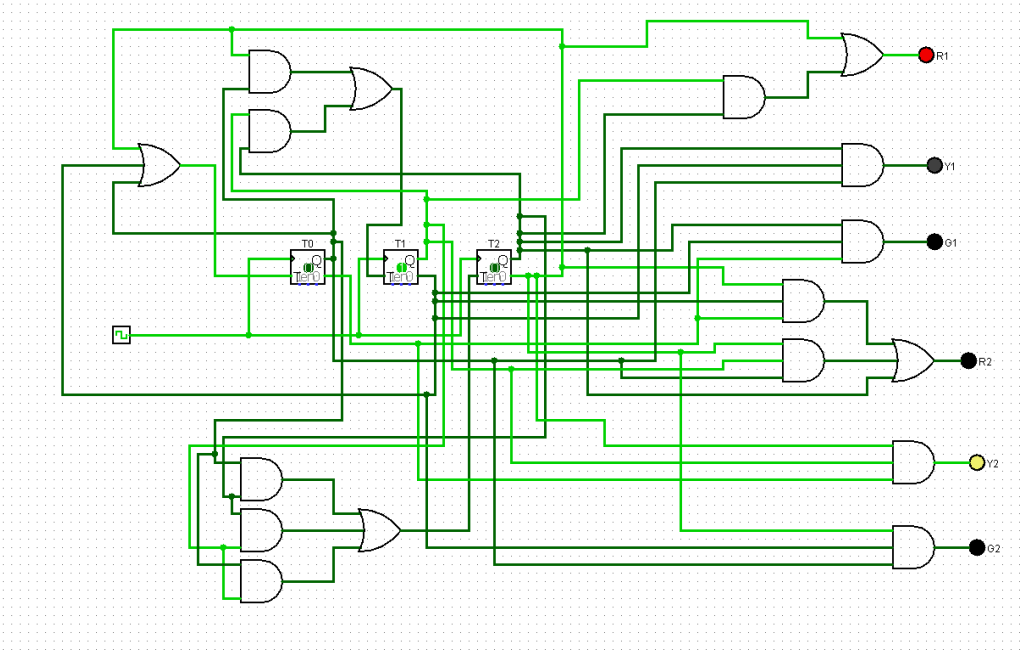
(j) Circuit Diagram



4. Design Verification using Logisim







5. Conclusion

In a nutshell, as human beings living in this gifted world by Allah, we must make use of the mind given by Him to make the world a better place for everyone. Seeking knowledge to do good deeds is part of Ibadah. As stated in Surah Al-Ankabut, Chapter 29, Verse 69, "And those who strive in Our (cause), We will certainly guide them to our Paths: For verily Allah is with those who do right." Therefore, it is our responsibility to use the gift given by Allah which is our Aql to help everyone around us. This project is about two-way traffic lights that help drivers to ensure their safety while driving. In this circuit, there are a lot of different combinational logic circuits that enable each output of the circuit. Just like this world, we are all different in each way in terms of skin colour, race, gender, and religion. However, we complement each other in making this world a unique and special place to live on. As stated in Surah Al-Hujurat, Chapter 49, Verse 13, "O mankind! We created you from a single (pair) of a male and a female, and made you into nations and tribes, that ye may know each other (not that ye may despise (each other). Verily the most honoured of you in the sight of Allah is (he who is) the most righteous of you. And Allah has full knowledge and is well acquainted (with all things)." Therefore, we must avoid discrimination and work with each other regardless of our difference to enhance the beauty of the world.